ATMOSPHERE/ENERGY UNDERGRADUATE MAJOR

COVID-19-Related Degree Requirement Changes
For information on how Atmosphere/Energy (A/E) degree requirements have been affected by the pandemic, see the "COVID-19 Policies" tab (http://exploredegrees.stanford.edu/schoolofengineering/civilandenvironmentalengineering/#covid19policies) in the "Civil and Environmental Engineering" of this bulletin. For University-wide policy changes related to the pandemic, see the "COVID-19 and Academic Continuity" section of this bulletin.

Atmosphere/Energy (A/E)
Completion of the undergraduate program in Atmosphere/Energy leads to the conferral of the Bachelor of Science in Engineering. The subplan "Atmosphere/Energy" appears on the transcript and on the diploma.

Mission of the Undergraduate Program in Atmosphere/Energy
Atmosphere and energy are strongly linked: fossil-fuel energy use contributes to air pollution, global warming, and weather modification; and changes in the atmosphere feed back to renewable energy resources, including wind, solar, hydroelectric, and wave resources. The mission of the undergraduate program in Atmosphere/Energy (A/E) is to provide students with the fundamental background necessary to understand large- and local-scale climate, air pollution, and energy problems and solve them through clean, renewable, and efficient energy systems. To accomplish this goal, students learn in detail the causes and proposed solutions to the problems, and learn to evaluate whether the proposed solutions are truly beneficial. A/E students take courses in renewable energy resources, indoor and outdoor air pollution, energy efficient buildings, climate change, renewable energy and clean-vehicle technologies, weather and storm systems, energy technologies in developing countries, electric grids, and air quality management. The curriculum is flexible. Depending upon their area of interest, students may take in-depth courses in energy or atmosphere and focus either on science, technology, or policy. The major is designed to provide students with excellent preparation for careers in industry, government, and science, technology, or policy. The major is designed to provide students with the fundamental background necessary to understand large- and local-scale climate, air pollution, and energy problems and solve them through clean, renewable, and efficient energy systems.

Requirements
Mathematics and Science (45 units minimum):

**Mathematics** 23 units minimum, including at least one course from each group:

**Group A**
- MATH 53: Ordinary Differential Equations with Linear Algebra
- CME 102: Ordinary Differential Equations for Engineers

**Group B**
- CME 106: Introduction to Probability and Statistics for Engineers
- STATS 60: Introduction to Statistical Methods: Precalculus
- STATS 101: Data Science 101
- STATS 110: Statistical Methods in Engineering and the Physical Sciences

**Science** 20 units minimum, including all of the following:
- PHYSICS 41: Mechanics
- PHYSICS 43: Electricity and Magnetism
  - or PHYSICS 45: Light and Heat
- CHEM 31B: Chemical Principles II
  - or CHEM 31M: Chemical Principles: From Molecules to Solids
- CEE 70: Environmental Science and Technology

**Technology in Society (1 course)** 3-5 units
One 3-5 unit course required; must be on School of Engineering Approved List the year taken.

**Writing in the Major (WIM)**
One 3-5 unit course required. Choose a WIM course that fulfills a WIM requirement:
- BIOE 131: Ethics in Bioengineering
- COMM 120W: The Rise of Digital Culture
- OR one of these WIM courses (do not fulfill TiS):
  - CEE 100: Managing Sustainable Building Projects
  - ENGR/CEE 102W: Technical and Professional Communication
  - EARTHSYS 200: Environmental Communication in Action: The SAGE Project

**Fundamentals and Depth:** At least 40 units total must be from the School of Engineering

**Engineering Fundamentals**
Two courses minimum (recommend 3), including at least one of the following: 7-9 units
- ENGR 50E: Introduction to Materials Science, Energy Emphasis (ENGR 25E also accepted (no longer offered))

**Plus at least one of the following:**
- ENGR 10: Introduction to Engineering Analysis

**A third Fundamental is optional but recommended (3-4 units):**
- CS 106A: Programming Methodology

**Engineering Depth**
Required: 6-8 units; introductory seminars may not count toward Engineering Depth
- CEE 64: Air Pollution and Global Warming: History, Science, and Solutions (cannot also fulfill science requirement)
- CEE 107A: Understanding Energy
  - or CEE 107S: Understanding Energy - Essentials

34-36 units from the following with at least four courses from each group; at least 40 of the units in ENGR Fundamentals and Depth must be from the School of Engineering:

**Group A: Atmosphere**
- AA 100: Introduction to Aeronautics and Astronautics
- CEE 63: Weather and Storms
- CEE 101B: Mechanics of Fluids
  - or ME 70: Introductory Fluids Engineering
- CEE 161I: Atmosphere, Ocean, and Climate Dynamics: The Atmospheric Circulation
- CEE 162I: Atmosphere, Ocean, and Climate Dynamics: The Ocean Circulation
- CEE 172: Air Quality Management
- CEE 178: Introduction to Human Exposure Analysis
- EARTHSYS 111: Biology and Global Change
  - or EARTHSYS 142: Remote Sensing of Land
  - or EARTHSYS 144: Fundamentals of Geographic Information Science (GIS)

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<thead>
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<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>EARTHSYS 159</td>
<td>Economic, Legal, and Political Analysis of Climate-Change Policy</td>
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<tr>
<td>EARTHSYS 188</td>
<td>Social and Environmental Tradeoffs in Climate Decision-Making</td>
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<tr>
<td>PHYSICS 199</td>
<td>The Physics of Energy and Climate Change</td>
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<td>EARTH 2</td>
<td>Climate and Society</td>
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<td>EARTHSYS 196</td>
<td>Implementing Climate Solutions at Scale</td>
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**Group B: Energy**

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<th>Course Code</th>
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<tr>
<td>CEE 107R</td>
<td>E^3: Extreme Energy Efficiency</td>
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<tr>
<td>CEE 156</td>
<td>Building Systems Design &amp; Analysis</td>
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<td>CEE 173S</td>
<td>Electricity Economics</td>
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<td>CEE 176A</td>
<td>Energy Efficient Buildings</td>
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<td>CEE 176B</td>
<td>100% Clean, Renewable Energy and Storage for Everything</td>
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<td>CEE 177S</td>
<td>Engineering and Sustainable Development</td>
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<tr>
<td>EARTHSYS 101</td>
<td>Energy and the Environment</td>
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<td>EARTHSYS 102</td>
<td>Fundamentals of Renewable Power</td>
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<td>ENERGY 104</td>
<td>Sustainable Energy for 9 Billion</td>
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<tr>
<td>ENGR 50E</td>
<td>Introduction to Materials Science, Energy Emphasis</td>
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<tr>
<td>MATSCI 144</td>
<td>Thermodynamic Evaluation of Green Energy Technologies</td>
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<td>MATSCI 156</td>
<td>Solar Cells, Fuel Cells, and Batteries: Materials for the Energy Solution</td>
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<td>ME 182</td>
<td>Electric Transportation</td>
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<td>POLISCI 73</td>
<td>Energy Policy in California and the West</td>
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<td>OSPSANTG 29</td>
<td>Sustainable Cities: Comparative Transportation Systems in Latin America</td>
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**Total Units**

95-101

1. Can count as a science requirement or Engineering Fundamental, but not both.
2. CEE 64 can count as a science requirement or as Engineering Depth, but not both.
3. ENGR 50E can count as Engineering Fundamental or Engineering Depth, but not both.
4. A course may only be counted towards one requirement; it may not be double-counted. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum Combined GPA for all courses in Engineering Fundamentals and Depth is 2.0.
5. Courses outside of the School of Engineering (SoE) do not count toward the 40 units of engineering coursework required in the Fundamentals plus Depth categories.

**Honors Program**

The A/E honors program offers eligible students the opportunity to engage in guided original research, or project design, over the course of an academic year. Interested student must adhere to the following requirements:

1. Prospective honors students write up and submit a 1-2 page letter applying to the honors program in A/E describing the problem to be investigated. The letter must be signed by the student, the current primary adviser, and the proposed honors adviser, if different, and submitted to the student services office in the Department of Civil and Environmental Engineering (CEE). The application must include an unofficial Stanford transcript. Applications must be received in the fourth quarter prior to graduation. It is strongly suggested that prospective honors students meet with the proposed honors adviser well in advance of submitting an application.
2. Students must maintain a GPA of at least 3.5.
3. Students must complete an honors thesis or project over a period of three quarters. The typical length of the written report is 15-20 pages. The deadline for submission of the report is to be decided by the honors adviser, but should be no later than the end of the third week in May.
4. The report must be read and evaluated by the student's honors adviser and one other reader. It is the student's responsibility to find and obtain both the adviser and the reader. At least one of the two must be a member of the Academic Council in the School of Engineering.
5. Students must present the completed work in an appropriate forum, e.g. in the same session as honors theses are presented in the department of the adviser. All honors programs require some public presentation of the thesis or project.
6. Students may take up to 10 units of CEE 199H Undergraduate Honors Thesis (optional). However, students must take ENGR 202S Directed Writing Projects or its equivalent (required). Units for the writing class are beyond those required for the A/E major.
7. Two copies of the signed thesis must be provided to the CEE student services office no later than two weeks before the end of the student's graduation quarter. A pdf of the thesis, including the signature page signed by both readers, should be submitted to the student services officer by May 15. Students will be sent email instructions on how to archive a permanent electronic copy in Terman Engineering library.

For additional information and sample programs, see the Handbook for Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu).